Red response

Studies on the role of primary care doctors in out-of-hospital emergency medicine

Erik Zakariassen

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Department of Public Health and Primary Health Care

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Erik Zakariassen

Places of employment:

National Centre for Emergency Primary Health Care, Uni health, Bergen, Norway.

and

Department of Research, Norwegian Air Ambulance Foundation, Drøbak, Norway.

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CONTENTS

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2. List of publications

This thesis is based on the following individual publications:

I. Zakariassen E, Hunskaar S**.** GPs' use of defibrillators and the national radio network in emergency primary healthcare in Norway. Scand J Prim Health Care 2008; 26: 123–8.

II. Zakariassen E, Hansen EH, Hunskaar S. Incidence of emergency contacts (red responses) to Norwegian emergency primary health care services in 2007 – a prospective observational study. Scand J Trauma Resusc Emerg Med 2009; 8: 30.

III. Zakariassen E, Hunskaar S. Involvement in emergency situations by primary care doctors on-call in Norway – a prospective population-based observational study (Manuscript). 6. March 2010 published in BMC Emerg Med. 2010; 10: 5.

IV. Zakariassen E, Sandvik H, Hunskaar S. Norwegian regular general practitioners' experiences with out-of-hours emergency situations and procedures. Emerg Med J 2008; 25: 528 –33.

3. Definitions and concepts

In the thesis several concept are used, and the most important ones are explained below to make sure that the readers and the author have the same understanding of them. They are presented in alphabetic order. The Norwegian word in square brackets.

Emergency medical communication centre (EMCC)[AMK-sentral]:

When someone calls the national emergency number 113 the call is routed to the nearest EMCC. EMCCs are in charge of the prehospital emergency recourses, and based on the problem presented the EMCCs will alarm the ambulances, doctors on-call and other resources if needed, e.g. the air ambulance.

Emergency primary care district [legevaktdistrikt]:

A geographical area consisting of one or several municipalities where focus is directed towards emergency medicine, and where doctors on-call, nurses, local emergency communication centres and casualty clinics are the main recourses.

General practitioner (GP) [allmennlege]:

A primary care doctor who normally works in a medical office, solo or in a group, who takes care of all sorts of medical problems and who also refers patients to specialists and hospitals in the secondary health care system.

Host municipality [vertskommune]:

When two or more municipalities organise their emergency primary health care services together in inter municipal co-operations, one municipality is responsible for doctors on-call and casualty clinics. This municipality is here called “the host municipality”. In some co-operations this responsibility alternates between the municipalities.

Inter-municipal co-operation [interkommunal legevakt]:

When two or more municipalities have organised their emergency primary care districts together and are sharing a doctor on-call and a casualty clinic it is called “an inter-municipal co-operation”. Out-of-hours inter-municipal co-operations are common.

Local emergency communication centre (LEMC) [legevaksentral]:

When someone calls the local emergency number the call is answered at an LEMC. The municipalities are obligated to have a local emergency number that inhabitants can call if they are in need of urgent medical assistance. During out-of-hours the LEMCs are often covering several municipalities.

National emergency number [nødnummer]:

When someone is in an immediate need of medical assistance, the intention is that they should call the three-digit national emergency number 113.

Norwegian Index of Medical Emergency Assistance (Index) [norsk indeks]:

The Index is used as a decision tool in the EMCCs to triage patients and decide the level of response. A red response is appropriate to potentially or manifestly life-threatening conditions. A yellow response is urgent, but the condition in question is not considered life-threatening at the moment, although medical attention is needed within short time. A green response has the lowest priority.

Regional health authorities [regionale helseforetak]:

The secondary health care service is organised and managed by four regional health authorities (RHA), with the central government as owner. In 2005 there were five RHAs; North, Mid, West, East and South.

Regular general practitioner (rGP) [fastlege]:

rGPs are general practitioners with a municipal contract. The rGPs have a list of patients who are their responsibility. Out-of-hours work is part of the rGP's work in the municipality.

Triage [hastegradsvurdering]:

Traditionally and historically triage is a process of sorting injured people into groups based on their need for immediate medical treatment, e.g. in hospitals, emergency rooms or on battlefields. In this thesis "triage" is used for the classification or decision concerning what response category the patients belong to; red, yellow or green response.

4. Abstracts

4.1 English summary

The aim of this thesis was to explore the role of the doctor in the emergency primary health care service in red response situations in Norway, including the doctors' experiences with a variety of emergency situations.

The Norwegian municipalities are responsible for medical support and treatment to every person in the municipality. This is managed through the primary health care services, also encompassing home nurses, regular general practitioners (rGPs), health visitors, midwives, nursing homes, out-of-hours services, casualty clinics, doctors on-call and a local emergency communication centre. The main resources in the emergency primary care services are the rGPs during office hours and the out-of-hours services, casualty clinics and doctors on-call out-of-hours.

The secondary health care services manage the ambulance services (vehicles, boats, airplanes and helicopters) and the emergency medical communication centres (EMCCs). When someone calls the national emergency number 113, a nurse at the EMCC does a triage of the patient's/patients' problem based on the Norwegian Index of Medical Emergency Assistance (Index). The triage shall result in one of three possible levels of urgency; red response, which concerns potentially or manifestly life-threatening situations and therefore has the highest priority; yellow response, which is urgent but where the condition in question is not considered life-threatening at the moment; and the green response, which has the lowest priority with no urgency.

If in need of medical attention during daytime (not life-threatening, but urgent), patients are supposed to contact their own rGP or call the local emergency communication centre (LEMC). Doctors on-call in the emergency primary care service in the municipalities shall be in a state of readiness 24 hours a day, with the out-of-hours services as an included part. The rGPs are equipped with radios. In potentially life-threatening situations patients are expected to call 113 to an EMCC. If the EMCC defines the problem as life-threatening the ambulance and doctor on-call shall be alerted by a radio alarm from the EMCC, and attend the patients at site. In some cities casualty clinics are open during office hours and some have open access 24/7. Inter-municipal co-operations, where one doctor is on-call out-of-hours covering all municipalities in the co-operation, are common.

The main objectives of the thesis were:

- To explore the emergency primary care services and the most urgent emergency patients, defined as red responses, in general.
- To explore the role of the doctors on-call and their experiences with red response patients.

The first sub-study (Paper I) explored the use of radio to receive and acknowledge alarms and the access to a defibrillator as a general rule for doctors on-call among all 282 host municipalities in the emergency primary care districts. The study showed that half of the host municipalities had doctors on-call who always used the radio and could receive and acknowledge alarms from the EMCCs. Indirectly, this indicates that the other half of the host municipalities in the emergency primary care services violated the public regulation of prehospital emergency services. Less than half of the host municipalities had defibrillators available for doctors on-call. Based on the population in the municipalities, the use of radio and access to a defibrillator were

most common in the smallest host municipalities (< 5 000 inhabitants). The use of radio to receive alarms and the access to a defibrillator were interpreted as indications of the emergency primary care districts' preparedness to act in emergency situations.

The second sub-study (Paper II) explored the numbers of red response patients that primarily were taken care of by the emergency primary care services. A 12 months data collection was performed in 2007 on a representative sample of seven emergency primary care districts, containing 18 municipalities and 216 000 inhabitants. Every contact to the emergency primary care services and every first action taken were recorded for every patient. Patients had contacted the casualty clinics or the local emergency communications centres by phone or by direct attendance, or they had called the EMCCs where the calls had been transferred to LEMCs or doctors on-call received an alarm. Patients were triaged based on the Index. During one year 85 288 contacts were recorded and of those 2.3 % were red responses. There were large differences in rates of red responses between the different emergency care districts. About one third of the red response patients had primarily contacted the EMCCs and more than half had contacted the emergency primary care service by phone or by direct attendance. Other health care personnel contacted the emergency primary care services on behalf of a red response patient in approximately one out of eight cases. Direct attendance to casualty clinics resulted in consultations by doctors in 90 % of the red response cases, while contact by phone resulted in call-out for doctors on-call and ambulances in most of the red response cases.

The third sub-study (Paper III) explored the primary care services' doctors' involvement in red response situations. Three EMCC areas were used as the catchment area for the data collection, containing 85 municipalities and about 816 000 inhabitants. During three months all red response situations were collected,

resulting in 5 105 situations that were analysed further. The EMCCs did not alert the doctors on-call by radio alarms in all red response cases, and the rate of alarms to doctors on-call varied much between the three EMCC districts. In total, the doctors on-call were alerted in less than half of the red response situations and the doctors on-call responded with a call-out in 43 % of the situations where an alarm was received. However, call-out as response was about the same among the doctors on-call in the emergency primary care services in all three EMCC areas. Regression analyses indicate that the most important factor for whether doctors on-call would be alerted or not was the EMCC area the doctors worked in.

Sub-study four (Paper IV) explored 12 months of experience with 14 emergency situations, eight emergency procedures and confidence in performing the different emergency procedures among rGPs that took part in out-of-hours work. Chest pain, psychiatric problems and asthma were the most common emergency situations. Venous access, oxygen on mask and IV medication/fluid were the most common emergency procedures performed. Self-confidence in performing the procedures was overall high, except for intubation. Doctors working in rural areas experienced more emergency situations and procedures. A higher level of self-confidence in emergency procedures was measured, compared to doctors working in more central primary care districts.

Main findings in the thesis;

- There was an insufficient radio use among doctors on-call in about half of the emergency primary care districts.
- There were large differences in numbers of doctors receiving alarms between the three areas.

- The most important factor with respect to doctors on- call being alerted or not was the individual EMCC.
- The rGPs took part in emergency care with an overall high self-confidence in performing emergency procedures.
- The emergency primary health care services constitute an important part of the out-of-hospital emergency system in Norway.

4.2 Norwegian summary - norsk sammendrag

Hovedmålet med avhandlingen var å undersøke hvilken rolle og erfaringer leger som jobber i primærhelsetjenesten har ved akuttmedisinske hendelser, definert som rød respons.

Norske kommuner har ansvaret for å ha et medisinsk forsvarlig tilbud til samtlige personer som oppholder seg innenfor kommunens grenser. Dette ansvaret forvaltes gjennom primærhelsetjenesten, bestående av fastlegeordningen, hjemmesykepleie, sykehjem, helsesøstertjeneste, jordmortjeneste, legevaktsentral og legevakt. Kommunene skal organisere tjenesten slik at fastlegene og leger på vakt har radiosamband (helseradio) og at legene aktivt bruker helseradioen.

Spesialisthelsetjenesten er ansvarlig for ambulansetjenesten (bil, båt, fly og helikopter) og den medisinske nødmeldetjenesten gjennom de akuttmedisinske kommunikasjonssentralene (AMK). Når noen ringer det medisinske nødnummeret 113, besvares telefonen på en AMK. Der vil en sykepleier bedømme problemstillingen ved hjelp av Medisinsk Indeks for nødmeldetjenesten (Indeks) og gi pasienten med det aktuelle problemet en hastegrad definert som henholdsvis rød respons (akutt, potensielt eller manifest livstruende problemstilling), gul respons

(haster, men ikke livstruende i øyeblikket), eller grønn respons (haster ikke). Ved akutt behov for legetilsyn på dagtid skal kommunens innbyggere i prinsippet oppsøke fastlegen sin, eventuelt ringe det kommunale legevaktnummeret til legevaktsentralen. Ved alvorlige, potensielt livstruende situasjoner skal innbyggerne ringe det nasjonale nødnummeret 113. Når rød respons er definert, skal legene i kommunene alarmeres over radio av AMKene. Legene skal selv vurdere hendelsen og rykke ut til pasienten om de anser det for å være nødvendig. Legevakttjenesten i kommunene skal være en beredskapsorganisasjon for akutt sykdom og skade gjennom hele døgnet, alle dager i uken. Normalforståelsen av begrepet ”legevakt” er et tilbud om medisinsk hjelp etter vanlig arbeidstid. Noen bykommuner har likevel døgnåpen legevakt hvor folk kan søke hjelp også på dagtid. Mange kommuner har gått sammen om å opprette større legevaktdistrikt gjennom interkommunale samarbeid. Det innebærer at flere kommuner deler på en lege som har vakt og en felles legevakt for innbyggerne i begge/alle kommunene. Kommunen der legevakten geografisk er plassert, kalles ”vertskommunen”. Begrepet ”legevakt” brukes, men på bakgrunn av at det akuttmedisinske tilbudet i kommunene skal være likt hele døgnet, er det viktig å presisere at det i prinsippet er en lege på vakt hele døgnet i alle kommuner alle dager i uken. Denne avhandlingen har sett på primærhelsetjenestens befatning med de sykeste og mest alvorlig skadete pasientene gjennom hele døgnet, de som på basis av Indeksen blir vurdert til å være i en potensielt eller manifest livstruende situasjon, definert som røde responser.

Målet med studiene var å få mer kunnskap om;

- Primærhelsetjenestens generelle befatning med rød-responspasienter.
- Legers spesielle erfaringer med rød-responspasienter når legene er på vakt i primærhelsetjenesten.

Første delstudie (Artikkel I) skulle tallfeste antall vertskommuner i legevaktdistriktene som har leger som er tilknyttet helseradionettet med radio, og antall vertskommuner i legevaktdistriktene som har en defibrillator tilgjengelig for legen i vakt, der defibrillatoren kan medbringes på uttrykning. Undersøkelsen viste at halvparten av landets legevaktdistrikt hadde leger som alltid brukte helseradio og kunne motta og kvittere på alarmer sendt fra AMK-sentralene. Det betyr at den andre halvparten av legevaktdistriktene delvis eller alltid brøt Forskrift om krav til akuttmedisinske tjenester utenfor sykehuset. Under halvparten av legevaktdistriktene hadde defibrillator tilgjengelig for legene på vakt. Basert på innbyggertallet i kommunene, var legevaktdistriktene med leger som brukte helseradioen og hadde defibrillator tilgjengelig, hovedsakelig små vertskommuner (< 5000 innbyggere). Tilgjengelighet på helseradionettet og tilgjengelighet til defibrillatorer ble brukt som indikatorer på legevaktdistriktets beredskap for å ta seg av akuttmedisinske problemstillinger.

Andre delstudie (Artikkel II) hadde som hensikt å tallfeste rød-responspasienter som primært ble tatt hånd om av legevaktene. Dataene ble samlet inn fra et representativt utvalg bestående av syv legevaktdistrikt med til sammen 18 kommuner og omtrent 216 000 innbyggere. Datainnsamlingen ble foretatt over et år (2007). Rød-responstilfeller utgjorde 2,3 % av totalt 85 288 kontakter. Det var store forskjeller i rater av rød-responstilfeller mellom legevaktdistriktene. Om lag en tredel kom via AMK-sentralene, og over halvparten hadde kontaktet legevakten direkte enten ved oppmøte eller per telefon. Helsepersonell kontaktet legevaktene på vegne av pasienter i ett av åtte tilfeller. Direkte oppmøte på legevaktene endte i all hovedsak opp som konsultasjon hos lege som første tiltak. Telefonhenvendelser endte i de fleste tilfellene med utrykning av lege og ambulanse til pasientene.

Tredje delstudie (Artikkel III) undersøkte involveringen leger i primærhelsetjenesten hadde ved alle røde responser via nødnummeret 113 i 2007. Tre AMK-sentraler som til sammen dekket 85 kommuner og bortimot 816 000 innbyggere, ble brukt som område for datainnsamlingen. Datainnsamlingen ble gjennomført over tre måneder, der alle rød-responstilfeller ble samlet inn. 5105 rød responssituasjoner ble registrert og analysert. Antall alarmer til legene i forhold til totalt antall røde responser og hvordan legene responderte på alarmene, ble tallfestet. Det var store forskjeller i alarmeringsmønster mellom de tre AMK-sentralene, noe som indikerte at AMK-sentralen var viktigste faktor for om legen ble varslet eller ikke. Totalt ble legene alarmert i under 50 % av rød responstilfellene, og legene rykket ut i omtrent 43 % av tilfellene der de ble alarmert. Når legene var varslet, var det mindre forskjeller i responsmønster blant legene på vakt. Når legene først var varslet, var hyppighet av uttrykning omtrent lik i de tre AMK områdene.

Fjerde delstudie (Artikkel IV) søkte å kartlegge de akuttmedisinske erfaringene til fastleger som har tatt legevakter siste 12 måneder. Fastlegene fikk spørsmål om erfaring med 14 forskjellige akuttmedisinske situasjoner og åtte forskjellige akuttmedisinske prosedyrer. Det ble også spurt om deres selvsikkerhet når det gjaldt å utføre de akuttmedisinske prosedyrene. Brystsmerter, psykiatriske problemer og astma/tungpust var de vanligste akuttmedisinske problemstillingene. Innleggelse av venekanyle, oksygen på maske og intravenøs medikamentering/væske var de vanligste akuttmedisinske prosedyrene. Selvsikkerheten når det gjaldt å utføre prosedyrer var generelt sett høy, også for prosedyrer som sjelden ble utført.

Hovedfunn

- Det er mangel på bruk av helseradio i halvparten av landets vertskommuner.
- Forskjellen i antall alarmerte legevaktleger mellom AMK distriktene var stor.

- Den viktigste faktor for hvorvidt legevaktlegen ble alarmert, var hvilken AMK sentral legen tilhørte.
- Fastleger tok del i akuttmedisinsk arbeid og hadde en god selvsikkerhet ved utførelse av akuttmedisinske prosedyrer.
- Legevakten er en viktig del av det akuttmedisinske systemet utenfor sykehuset.

5. Introduction

The government wants to have a decentralised pattern of settlement in Norway, and obtaining equality in health care is a stated political goal (1). The municipalities are responsible for the emergency primary health care system, including out-of-hours services and local emergency medical communication centres (LEMC) (2, 3). Primary care doctors are expected to have an important role in the "chain of survival", especially in rural areas (4). It has been claimed that the participation of primary care doctors in emergency situations is decreasing, and that the patients are increasingly taken care of by the ambulance personnel alone (4). We know that just half of the regular general practitioners (rGPs) take part in the out-of-hours work (5, 6). The consequence of this is that out-of-hours shifts are taken by other doctors such as doctors in internship, doctors normally working in hospitals, and stand-in doctors from other Scandinavian countries. The Norwegian Medical Association and Norwegian Directory of Health has recommended that municipalities take part in co-operations, based on the argument that this will increase the quality in the out-of-hours services, decrease the load of out-of-hours shifts and therefore increase recruitment of young doctors to the primary health care services (7, 8). The part of the argument concerning an expected increase in quality lacks documentation, and working in inter-municipal co-operations does not seem to increase the rGPs' commitment to take out-of-hours shifts (5).

Rural areas have other challenges than city areas. The distance between doctors/ambulances and inhabitants is longer in rural areas. The Office of Auditor General of Norway has reported that more ambulance personnel work without formal education in rural areas, compared to city areas (9). In red response cases, where medical treatment is crucial within short time, the doctors on-call have a more important role in these areas, as compared to city areas. Establishing inter-municipal co-operations increases the area for which the doctors on-call are responsible. A

consequence of inter-municipal co-operation is longer distances between patients and the doctor on-call in the area.

A strict gatekeeper function is carried out by the primary health care services. An important principal rule in Norway is that no person can meet directly at emergency departments at the hospitals (self-referral). Patients have to be admitted by a doctor, except when ambulance personnel consider the patient to have a life-threatening problem, in which case the patient will normally be taken directly to the emergency departments (ED).

In the years from 1980 to 2001 the number of man-years for doctors in the secondary health care services increased from 8.8 to 16 per 10 000 inhabitants, while there was no increase in the primary health care system (10). In 2009 Norway had four regional health authorities, 430 municipalities and 228 emergency primary care districts, of which 112 were inter-municipal co-operations (11).

The out-of-hospital emergency system is divided between two levels of organisation; the primary and the secondary health care services.

5.1 The emergency primary care services

The functions of the primary health care services, including the out-of-hours services, are described in laws and regulations:

- Act relating to the municipal health services (3).
- Regulation on emergency medicine outside hospitals (2).

Basically, the act contains paragraphs on the municipal responsibility for the people inside the municipality's border, e.g. that there is a requirement to have a doctor on-call 24 hours a day. The regulation is more to the point and specific regarding responsibility in emergency situations within the area of the emergency primary district.

During office hours the emergency primary care services consist of regular general practitioners (rGPs). They shall have time available for patients who are in need of urgent medical attention. The patients shall as a principle contact their own rGP during office hours. Out-of-hours patients shall contact the LEMCs to get access to casualty clinics and doctors on-call. Some of the largest Norwegian cities have casualty clinics with open access also during offices hours.

In the emergency primary health care services there are different models of organisation among the municipalities during both office hours and out-of-hours (12). A municipality will normally have organised the emergency primary health care services within its own borders during office hours, but for the out-of-hours it is more common to be a part of a co-operation between several municipalities (inter-municipal co-operation), where the emergency primary district covers several municipalities.

An important part of the population's safety net in the municipalities is the location of the ambulances; their services are managed by the regional health authorities (RHA) and are not under the control of the municipalities. By 2006, one fourth of the municipalities did not have an ambulance within their own borders, half had one ambulance, and 11 % had an ambulance boat (13). The municipalities are responsible for providing transport for their doctors on-call (3). Still, half of the doctors on-call

would usually use a private car on call-outs, one fourth would usually board the ambulances, while using an emergency car provided by the municipalities was less common (13).

In a report dealing with the emergency preparedness in the secondary health care services, the Office of Auditor General of Norway wrote that cooperation between the secondary and the primary health care services is difficult in many areas. Transmitting alarms and communication through the radio system constitute one of those problems. It is well known that there is a lack of responsibility to acknowledge alarms among the primary care doctors during office hours. During out-of-hours there is normally one doctor on-call, and the responsibility is clear, but the secondary health care system complains about the lack of radio use also among doctors on-call out-of-hours (9). When doctors on-call acknowledge alarms in red response cases they rarely attend the patients. The Office of Auditor General of Norway refers to this as a lack of emergency preparedness in the emergency primary health care service (9). The conclusions in the report are solely based on answers, opinions and statistics from the secondary health care services.

Experience in emergency situations among doctors in the emergency primary care service is unknown. One earlier study showed little experience with emergency procedures among GPs in Norway. Doctors who worked close to hospitals were less confident with emergency procedures compared to doctors who worked further away from hospitals. The study was based on GPs in general and not GPs who took part in out-of-hours work, where most emergency situations occur (14). More knowledge is needed regarding experiences both with respect to emergency situations and with respect to emergency procedures among GPs doing out-of-hours shifts.

5.1.1 Local emergency medical communication centre

A local emergency medical communication centre (LEMC) is the emergency primary care district's own centre for support and triage of inhabitants with medical problems. The LEMCs have an ordinary eight digit phone number which is exclusively used in one municipality or one emergency primary health care district. The general rule is than one should call the LEMC when help from the primary care services is needed within a short time, but not immediately as in a life-threatening situation. The LEMCs are mainly staffed with nurses. Based one the severity of the problem the nurses can give advice to the caller, offer a consultation at the casualty clinic or ask the caller to contact their own rGP the same or the next day. In a red response situation the nurses will send an alarm to the doctor on-call and the ambulance, and/or transfer the call and the responsibility of the situation to the nearest emergency medical communication centre (EMCC). In 21 % of the emergency primary care districts LEMCs and casualty clinics were under the same roof in 2006 (12). Nursing homes are also used as LEMCs. Nurses and other health care personnel are there assigned the task of answering the phone. Some emergency primary care districts have outsourced the LEMCs and the function is taken care of by the nearest EMCC or by private companies. People in the primary emergency districts can call the LEMCs 24 hours. In 2009 there were 153 LEMCs in Norway (11).

There are no national data from the LEMCs regarding contact rates, severity of problems, numbers of red responses and how the LEMCs handle the red response contacts.

5.1.2 Casualty clinics

All inhabitants in the municipalities have access to a casualty clinic. In some municipalities the inhabitants have to call the LEMC and a prejudgement will be

made before access to the casualty clinic is permitted. In the largest cities self-referral is common and the casualty clinics are open 24 hours a day. In most of the rural emergency primary care districts the doctor's medical office in the host municipality will normally function as a "casualty clinic" out-of-hours. 15 % of the casualty clinics were located at hospitals in 2006, mostly in densely populated areas. More than half of the casualty clinics in the primary care districts had frequent training with the ambulance services in the same areas (12). There is no regulation or national standard concerning requirements for the various types of equipment needed in the casualty clinics. A study of host municipalities showed that ECG, oxygen and ventilation equipment, defibrillator and emergency bag were commonly available (15).

The intention is that inhabitants shall seek help with their own rGP during daytime also if they think they need help within a short time. If the emergency problem occurs after office hours, inhabitants shall use the out-of-hours services/casualty clinics. It seems that the out-of-hours services, and especially casualty clinics with open access in cities, are more used as ordinary medical offices for minor problems than as an emergency care unit for urgent medical problems (16), as self-referral patients are not able to distinguish between minor problems and more urgent problems before they are examined. Another issue is that some people probably find it more convenient to visit the casualty clinic after work instead of visiting the rGP during office hours. People also contact LEMCs or casualty clinics for medical problems for which it would have been more adequate to contact the EMCCs. Therefore, red responses in out-of-hours (LEMCs and casualty clinics) do occur when LEMCs or casualty clinics are the first contact point for the patients. There is no national system to generate data on mode of contact or first action taken when the patients are triaged as red responses in the emergency primary care service/out-of-hours services.

Summary

It is stated in reports, articles and white papers that the emergency primary care system is an important part ("the backbone") of the out-of-hospital emergency system (4, 17, 18). There are reports in which municipalities' preparedness to act in emergencies and their ability to take the responsibility of the patients as stated in regulations, are questioned (9). Doctors' use of radio to receive alarms from the EMCCs, their access to equipment in emergencies, the number of red responses in the emergency primary care services, mode of contact, action taken and experiences with emergency situations among GPs taking out-of-hours work, are all factors with an absence of good statistical data on a national basis in Norway.

5.2 The emergency secondary care services

The secondary health care service is managed by the government through four regional health authorities (RHA). The RHAs are responsible for the hospitals, vehicle, boat and air ambulance services, and the EMCCs. The air ambulances consist of both helicopters and fixed wing airplanes (19). The functions and tasks of the secondary health care services are described in Act related to the specialist health service and Regulation on emergency medicine outside hospitals (2, 19). The Regulation on emergency medicine outside hospitals comprises different paragraphs dealing with tasks and responsibilities. §4 specifies the interaction between the primary and the secondary health care services, and the necessity of cooperation between them in emergency situations is explicitly emphasised.

The secondary health care service is responsible for the medical treatment performed by the ambulance personnel. However, if a doctor in the primary care service is with the patients e.g. on a red response, the doctor is in charge and responsible. The interaction between the two levels of emergency care is important, and sometimes probably difficult (20). Good cooperation is challenged by the fact that both the

primary and the secondary health care systems are defined as responsible for the same patient in emergency situations.

Reports claim that doctors on-call do not fulfil their obligations in emergency situations (4, 9), but the reports do not present any statistical data to underpin these assertions.

5.2.1 Regional emergency medical communication centre

In severe emergencies (acute, potentially life-threatening) inhabitants are supposed to call the three-digit emergency number 113 to an emergency medical communication centre (EMCC). There were 19 EMCCs in Norway in 2009 (21).

When calling the emergency number 113, the call is routed to the nearest EMCC. Based on a decision tool, Norwegian Index for Medical Emergencies (Index) (22), used by nurses working in the EMCCs, problems will be classified into three different levels of responses represented by colour codes. Immediate need of help (acute, life-threatening) is denoted by the colour red. Yellow denotes urgent but not immediate life-threatening conditions, and green denotes the situations with the lowest priority. A restricted and nationwide medical radio network (radio) is used for communication between doctors on-call, ambulance personnel and EMCCs. When an emergency is classified as red there shall be a simultaneous alarm on the radio to both the primary care doctor on-call and the nearest ambulance, according to Regulation on emergency medicine outside hospitals (2) and the Index (22). The intention is that the ambulance and the primary care doctor on-call shall attend the patient and work as a team (2).

Is “the backbone” of the out-of-hospital emergency system in Norway used in red responses? The doctors on-call in the emergency primary health care shall receive an alarm from the EMCCs together with the ambulances in all red response cases. A matter of concern is to which extent this is done. Do the doctors on-call receive alarms in all red response cases, do geographical differences exist, and what are the doctors’ response to alarms? What is the total involvement in red response cases by the doctors in the primary care services? Representative data are needed to answer the important questions with respect to developing the out-of-hospital emergency service. Concerns have been expressed about the emergency primary care services and their ability and willingness to act in emergency situations (4, 9), but there are few data to confirm those statements. A study from the National Centre for Emergency Primary Health Care and National Centre on Emergency Communication in Health gave some answers regarding alarms. It showed that, overall, EMCCs alerted doctors on-call in approximately half of the red response cases, but there were large variations between the different EMCCs (23). Due to methodological issues, e.g. the fact that the length of the registration period is uncertain and that there are probably differences between the EMCCs regarding this issue, the results have some limitations.

Summary

The necessity of cooperation between the primary and the secondary health care is stated in the Regulation on emergency medicine outside hospitals (2). The secondary health care service shall take care of red response cases in cooperation with doctors on-call. The secondary health care system expects that doctors on-call acknowledge alarms sent from the EMCCs and attend emergencies together with the ambulance services. Reports have claimed that the doctors on-call do not fulfil their obligations in emergency situations, that they do not acknowledge alarms, and are not doing call-outs to patients as often as they should, but no statistical data have been presented to support these claims. There is a lack of epidemiological data and knowledge on cooperation between the primary and the secondary health care services regarding red

responses outside hospitals in Norway. Earlier reports, white papers, and plans concerning the organisation of the emergency services underscore the lack of national statistics and scarce epidemiological knowledge (4, 9, 24-27).

5.3 Education and competence

The Health Personnel Act has an extensive list of professions defined as health personnel (28). Amongst others the list includes ambulance personnel, doctors, nurses, enrolled nurses, medical secretaries and social educators. Nurses are educated at a college and have a bachelor degree, while enrolled nurses and medical secretaries have three years in upper secondary school. According to the Regulation on emergency medicine outside hospitals EMCCs and LEMCs shall be staffed with health personnel (2). The regulation does not specify what kind of health personnel this should be, e.g. both nurses and medical secretaries appear to qualify.

The EMCCs are normally staffed with nurses who answer the emergency calls and decide the response code (red, yellow or green) of the problem. The nurses shall have clinical experience in emergency medicine and they are trained in using the Index. Ambulance personnel are often used as coordinators of the resources outside hospitals.

The LEMCs are also normally staffed with nurses, often with the same clinical experiences and training in Index use as the nurses in the EMCCs. However, it is reported that nearly one third of the municipalities used other health care personnel than nurses, where the most commonly used were medical secretaries (29).

For doctors doing emergency primary care work, including out-of-hours work, no formal education or courses are required, except being an authorised doctor. Approved GP specialists have to take a course in emergency medicine every fifth year to retain the approval. Local doctors with good knowledge of the inhabitants' morbidity, good knowledge of the emergency primary care district's recourses and united competency, and several years of experience in patient care, will probably have an overall higher competency compared to e.g. a stand-in or a doctor in an internship.

The formal education for ambulance personnel is two years in upper secondary school and two years in apprenticeship, which results in the attainment of a certificate of apprenticeship. Ambulance vehicles shall be staffed with two persons and at minimum one of them shall have a certificate of apprenticeship (2). A report from the Office of Auditor General of Norway claims that 56 % of the ambulance personnel in Norway had a certificate of apprenticeship in 2004, with large variations between the health regions (9). In 2008 the percentage had increased to 68 % (total), with a variation between 50 % to 73 % among the health regions (10).

5.4 Other countries and some examples of emergency medical services

It is difficult to write about prehospital emergency care as if "prehospital emergency care" is a uniform or homogenous concept among countries. A dichotomy of the emergency systems has been proposed, where the Anglo-American and the Franco-German are two main systems. In the former, the patient is brought to the doctor, and in the latter the doctor is brought to the patient (30). Among eleven countries where descriptions of their emergency medical services were presented, GPs were defined as a resource in six of them (Norway, Finland, Denmark, France, UK and Iceland) (17, 31-37). The Australian article did not mention GPs (37), but in other parts of

Australia GPs work in prehospital emergency care (38, 39). The primary health care services are seen as an important part of the health care service in several countries. The main reasons are an older population, higher morbidity with chronic diseases and increasing pressure at hospitals (40). The result is an effort to make primary care service capable of delivering more advanced and complex care to improve outcome and reduce the costs for the total health care systems (40, 41).

GPs as emergency doctors in out-of-hours work

Providing a content definition of "emergency medical services" is difficult (42) and so is providing a content definition of "out-of-hours work" (43). Out-of-hours work is not the same in e.g. The Netherlands as it is in Norway. In The Netherlands GP out-of-hours work is basically organised to address medical problems with a lower level of urgency, and self-referral to EDs at hospitals is allowed (44). In Norway out-of-hours work is basically organised to address emergency problems (27), and self-referral to EDs at hospitals is not allowed. The out-of-hours work is included in the general category of prehospital emergency medicine together with the ambulance services and the EMCCs (2). Different models for how to organise the primary/out-of-hours system exist among countries (43). In Norway, Iceland, Ireland, New Zealand and Australia the GPs have an evident role in out-of-hospital emergencies as part of primary care work /out-of-hours work, especially in rural areas (17, 45-49). The GPs will receive alarms and are expected to attend the patients in the field and cooperate with the ambulances. In UK, France and Denmark the role is more diffuse regarding emergencies (17, 31, 32). In Copenhagen, especially trained emergency physicians are part of the out-of-hospital emergency system (50).

Out-of-hours and GP co-operatives

GP co-operatives are common in several countries. Denmark has GP out-of-hours co-

operatives where GPs answer telephones, give advices and make home visits. In emergencies the inhabitants call the emergency number 112 in order to get an ambulance, or they meet directly at the ED at hospitals (self-referrals) (51, 52). The Netherlands has GP co-operatives with telephone triage/advice handled by nurses, and the level of care is decided based on the nature of the problem, e.g. that the patient is allowed to visit the casualty clinic. Inhabitants can also call the national emergency number (ambulances) or choose to meet directly at the hospitals' EDs (self-referrals) (44, 53). In life-threatening situations if all ambulances are occupied a GP from the co-operative can make a call-out to the patient (52). In UK, after new contracts were introduced in 2004, GPs were allowed to opt out of 24-hours care. GP co-operatives are common, but so are private companies and hospitals in out-of-hours care (52). Inter-municipal co-operations are common in Norway. It is not a co-operation between several GPs, but a co-operation between different municipalities to secure a proper public out-of-hours service.

Emergency systems without GPs

In Sweden, UK (volunteer), US, Canada, Portugal, Germany and Greece the primary health care services are not an assigned part of the out-of-hospital emergency system (17, 30, 32-36, 54). In several of these countries doctors make up an important component of the ambulance services, but most often as specialised emergency physicians.

Self-referral to Emergency Departments

In Norway self-referral to hospitals/EDs is normally not possible. Self-referral to EDs seems to be a problem of concern in many countries because of the overcrowding of patients that may arise (UK, The Netherlands, Ireland, Sweden and Denmark) (43,

55-59). In UK it is argued that the current out-of-hours care is not good enough and that patients prefer hospitals because there is no alternative (60). In countries where self-referral to EDs is allowed, the pressure on the emergency primary care services is probably reduced and the epidemiology of the patients attending the primary care system differs from those countries where patients attend to the hospitals directly (61, 62). Self-referrals constituted a large group among all patients that contacted the hospitals, but still a small group relative to the total out-of-hours demand (61). In Norway, where self-referral is not possible, more emergency patients will be routed trough the primary care system and the doctor on-call will probably experience more emergency patients at the casualty clinic or in the field together with the ambulance services. This also strengthens the gatekeeper function taken care of by the doctors on-call in the emergency primary care services.

A report from UK claims that the gatekeeper function is reduced with less experienced doctors and with short distances to hospitals. Emergency departments are not the right environment for a good gatekeeper function where doctors tend to overestimate risk, resulting in increasing use of diagnostic tests with growing costs and patients time as consequences (63). The gatekeeper function performed by the primary health care service is important. The ability to sort the patients before hospitalisation increases the probability that the specialists in the hospital will be able to spend their time on the right patients.

5.5 Epidemiological data on emergency medicine

In order to make the right political decisions with respect to the future organisation of the emergency services outside hospitals, there is a need for more epidemiological knowledge. Is focus on cardiac arrests and the chain of survival the most important task, or is focus towards an out-of-hospital emergency service that has the competency to deal with an increasingly older population more important? Earlier

reports, white papers and plans concerning the organisation of the emergency services underscore the lack of national statistics and scarce epidemiological knowledge of the content of red responses (4, 9, 24-27). After searches on PubMed and Embase there seems to be few publications where the entire epidemiology of prehospital emergencies is described. Many epidemiology studies deal with specific emergency problems such as cardiac arrest, chest pain or trauma (64-70), while one study has wider epidemiological descriptions of the content of red responses in Norway (71).

6 . Aims of the studies included in the thesis

The aim of this thesis was to examine the role and experience of the doctor in the emergency primary health care service in red response situations in Norway. Four sub-studies (Studies I–IV) were carried out to achieve the aims, and the results were published in four articles (Paper I–IV).

Study I:

The aim was to assess the percentage of out-of-hours districts with doctors on-call using the national radio network and their access to a defibrillator on call-out as a measure of the preparedness of doctors on-calls with respect to contributing in a red response situation.

Study II:

The aim was to explore the mode of contact and first action taken in the emergency primary health care services when patients were triaged to be a red response.

Study III:

The aim was to explore who received alarms, responses to alarms, severity and endpoints in red response cases in three EMCCs and their total numbers of red response patients during a period of three months.

Study IV:

The aim was to examine one year of experience with 14 potential life-threatening situations and eight emergency procedures among rGPs who took part in out-of-hours work.

7. Materials, methods and results of individual studies

In this section a brief description of the material, methods and results of the four studies is presented. A survey design was used in all four studies, but with different approaches. Study I and IV were cross-sectional studies using questionnaires and Study II and III were longitudinal observational studies.

7.1 Materials, methods and results of Study I

GPs' use of defibrillator and the national radio network in emergency primary health care in Norway.

Materials and methods

The National Centre for Emergency Primary Health Care has established a national registry study with the objective to establish information on several aspects within the municipalities and the emergency primary health care services. The persons in charge of the municipal out-of-hours service answered the questionnaire. Collection of data is performed every second year with basically the same variables, which makes it easy to compare findings between the years. The data collection was performed as a whole by the National Centre for Emergency Primary Health Care. In autumn 2005 all municipalities were sent a questionnaire dealing with several aspects of their emergency primary health care services, e.g. organisation (municipal or inter-municipal co-operatives), type and common use of equipment and type of transportation on call-outs. Study I used data on radio use to receive and acknowledge alarms, access to a defibrillator, type of transportation on call-out and demographic data received from Statistics Norway.

The objective of the study was to investigate how the municipalities were prepared to act in an emergency situation based on routines regarding radio use and access to defibrillators for doctors on-call.

Results

All municipalities answered the questionnaire (100 % response rate). The median population in an emergency primary care district was close to 7 000 inhabitants, but with a wide range between RHAs and inside the same RHA. Inter-municipal co-operations seem to double both area and population one doctor on-call must cover during out-of-hours. Still, the size of the population in the emergency primary care districts indicates that many doctors on-call rarely experience emergencies where patients are in a life-threatening situation.

The national radio network was reported as always used by the doctors in 52 % of the host municipalities. In RHA Mid 70 % of the municipalities had doctors on-call with access to the radio network, compared to 17 % in RHA East. The largest differences in doctors' access to a radio were between the municipalities. It was in the municipalities with 5 000 inhabitants or less (small municipality) that doctors on-call mostly had access to a radio. The smallest municipalities had statistically significantly ($p<0.001$) more often doctors on-call with access to the radio network. RHA Mid, West and North had the highest numbers of small host municipalities.

In total, 46 % of the municipalities in Norway reported that doctors on-call had access to their own defibrillator (not the one placed in the ambulances). Based on population, the smallest municipalities had statistically significantly ($p<0.001$) more often doctors on-call with access to defibrillators. In RHA South 23 % of the

municipalities had a defibrillator, compared to 59 % of the municipalities in RHA Mid. 46 % of the doctors who used a private car on a call-out brought a defibrillator.

In total, 50 % of the municipalities reported that doctors on-call used private cars in emergencies, but with large variations between the RHAs. Use of private cars was most common in municipalities in RHAs East and South compared to the three other RHAs. In RHA South 73 % used private cars compared to 34 % in RHA North. In nearly one third of the municipalities it was reported that the doctors always joined the ambulances in emergency situations. In RHA North 41 % of the municipalities reported that doctors always joined the ambulances, while the figures for RHAs East and South were 13 %.

7.2 Materials, methods and results of Study II

Incidence of emergency contacts (red responses) to Norwegian emergency primary health care services in 2007 – a prospective observational study.

Materials and methods

The National Centre for Emergency Primary Health Care has started an enterprise called “The Watchtowers” consisting of a representative sample of seven emergency care districts. A prospective observational study was done over the course of one year to investigate contact type to the emergency primary health care services, first action taken by the emergency primary care services and response (red, yellow or green).

The sample of emergency primary care districts is based on motivated and voluntary municipalities. In order to select a sample as representative as possible for Norwegian municipalities as a whole and also reflecting the different organisational models for

emergency primary care districts that participated in the "Watchtowers", Norwegian Social Science Data Service selected seven emergency care districts based on several statistical dimensions (16, 72). Those seven emergency primary care districts constitute 18 municipalities. The selected emergency care districts had a total of 216 030 inhabitants in 2007, 4.6 % of the Norwegian population. All types of contacts to the primary care services, both direct attendance and telephone contacts, were recorded over the course of one ear.

Priority grade (triage) and first response initiated belonging to the same cases were also recorded. The following variables were recorded: Nationality of the patient, time of contact, gender of patient, age of patient, mode of contact (telephone, direct attendance to casualty clinic, contacts by other health professionals, contact by EMCCs or other, e.g. police), first action initiated (telephone advice by nurse, telephone advice by doctor, medical examination by a doctor, medical consultation by a nurse, home visit by doctor, acute response by ambulance and doctors, and other, e.g. acute response by ambulance alone) and priority degree according to the Norwegian Index for Medical Emergency (22). The variables were computed in an excel-file and sent to the National Centre for Emergency Primary Health Care once a month. Study II obtained the data from the "Watchtower" and consists solely of the cases triaged as red responses.

Results

Out of 85 288 contacts to the primary emergency care services 1 946 (2.3 %) were triaged as red responses. This corresponds to a rate of 9 per 1 000 inhabitants per year. Differences in rates between the districts are large and varied from 6 to17 per 1 000 inhabitants. The rate of the oldest inhabitants (60 +) was nearly three times higher than that of the age group 40–59 years; 20 versus 7 per 1 000.

Two thirds of all patients contacted the primary health care service directly by telephone, through self-referral or by other health care personnel on behalf of the patients. One third of the contacts came through EMCCs and resulted in call-out for a primary care doctor and ambulance or a call-out for ambulance alone in 73 % of the cases. In 48 % of the red responses, the first action taken was call-out of doctor and ambulance. In first action taken there were minor differences for the variables gender, age and time of day, except for the oldest age group (60+), where there were statistically significantly higher associations (Odds Ratio) between the age group 60+ and "consultation doctor" and "call-out doctor and ambulance". In cases of direct attendance 90 % of the patients got a consultation by a doctor.

A one year national estimate gives approximately 42 000 red response patients that were handled by the emergency primary health care services. The emergency primary care services were the first contact point for two thirds of the red response patients.

7.3 Materials, methods and results of Study III

Involvement in emergency situations by primary care doctors on-call in Norway – a prospective population-based observational study.

Materials and methods

A prospective population-based study was designed to investigate how a red response is handled by the doctors on-call in the emergency primary health care services. In addition to that we could investigate how EMCCs administrate red responses.

In 2007 the EMCC areas of Innlandet, Stavanger and Haugesund were chosen as catchment area for data collection. The areas cover a total of 816 000 inhabitants

which is approximately 20 % of the Norwegian population. All EMCCs in Norway use a software called “Acute Medical Information System” (AMIS). An AMIS form contains information regarding the administration of the red response, such as time of day, date, time for alarms to prehospital recourses, who responded, response time, criteria code and where the patients were transported. The three EMCCs sent us AMIS forms on every red response patient during a period of three months together with ambulance records. A meeting was arranged between the leaders of the EMCCs before starting the data collection to secure a uniform use of AMIS. Based on AMIS and ambulance records we were able to check if both the primary care doctors and air ambulances had received an alarm and we could also investigate their responses. In the cases in which they were involved we sent requests for copies of medical records.

Results

During three months 5 105 red response incidents were recorded and included in the study. This gave a rate of 6.1 red response cases per 1 000 inhabitants over the period of three months. Next of kin was the main caller (34%). Health care personnel, LEMCs and doctors made more than a third of the calls to the EMCCs altogether. Ambulances received alarms in 96 % of the cases, doctors on-call in 47 % and air ambulances in 8 % of the cases (doctors as caller and secondary mission for the air ambulances were excluded). The percentage of alarms sent to doctors on-call in red response cases showed different alarm patterns between the three EMCCs. When doctors received an alarm they responded with a call-out in 42 % of the cases in the total area. The differences between the three EMCCs districts with respect to doctors’ responses to call-outs were minor ($p=0.056$).

The patient’s location was in the majority of the cases private homes. When doctors called for ambulances approximately 40 % of the patients were in private homes and 40 % in surgeries and nursing homes. When doctors received alarms from the

EMCCs, private homes were the location in two thirds of the cases, one third was public places and a minor part of the patients were in nursing homes.

When receiving alarmes, more than half of the doctors received the alarm at the same time as the ambulances and 87 % within the first five minutes. There were differences between the EMCCs, and Innlandet alarmed 67 % within the first 5 minutes after the ambulances had received an alarm, Stavanger 95 % and Haugesund 83 % ($p<0.001$).

Doctors on-call received alarms in 38 % of the same cases as the air ambulances/anaesthetists in Innlandet, 68 % in Haugesund and 78 % in the area of Stavanger ($p<0.000$). When the doctors on-call received alarms they responded in 64 % of the same cases as the air ambulances/anaesthetists in Innlandet, 72 % in Haugesund and 53 % in Stavanger ($p<0.04$).

Doctors on-call were involved in more than 40 % of the red response cases. When daytime activities are included, primary care doctors in the emergency took part in half of all red response incidents. When doctors on-call received alarms 16 % of the patients were transported directly to hospitals without a doctor's confirmation, compared to 31 % when doctors on-call did not receive an alarm. More than a fourth of all red response patients were transported to a casualty clinic and one fourth were transported directly to hospitals without the involvement of a doctor.

Doctors on-call in remote municipalities responded more often with call-out, compared to those in central municipalities. Based on NACA-score, EMCCs alarmed doctors on-call in half of the life-threatening situations, compared to less than half in non life-threatening situations ($p<0.004$). Doctors on-call responded with call-outs

more often in life-threatening situations than in non-life-threatening situations ($p<0.000$).

Regression analyses showed a strong association between EMCC area and doctors on-call receiving an alarm. There was also a positive association between doctors on-call receiving an alarm, remote municipalities and non-life-threatening situations. Low severity scores on NACA were associated with a higher possibility of call-out as response among the primary care doctors. There was a positive, statistically significant association between call-out and remote municipalities in the total area, but when splitting up the areas this was statistically significant just in Stavanger area. When the air ambulance is on call-out the probability of the emergency primary care doctor doing a call-out to the same situation was reduced in the areas of Innlandet and Haugesund, compared with Stavanger.

7.4 Materials, methods and results of Study IV

Norwegian regular general practitioners' experiences with out-of-hours emergency situations and procedures.

Materials and methods

A questionnaire was sent to all regular general practitioners (rGPs) in Norway in 2006. The questionnaire consisted of two parts. The first part contained questions regarding gender, age and number of on-call duties per month in the emergency primary health care services workload (5). Those rGPs who had been on-call in the primary health care services at least one time during the last 12 months should also answer part two of the questionnaire. Part two contained questions about 14 different potentially life-threatening emergency problems in which respiration and/or circulation could be affected. The rGPs should enter the number of times during the

last 12 months they had addressed those emergency situations. There were questions concerning eight emergency procedures and the rGPs should answer how often it had been necessary to perform them. Regarding the procedures we asked who had performed them (e.g. the primary care doctor, ambulance personnel or other health care providers), and level of self-confidence among the doctors in performing those emergency procedures was recorded.

Results

2 913 (78 %) of the rGPs returned the questionnaire and 1 832 (63 %) had taken part in out-of-hours work during the last 12 months. 95 % of the 1 832 doctors who had taken part in out-of-hours work answered the questionnaire on emergency situations and procedures. Response rates for the individual items in the questionnaire were between 74 % and 91 % except for questions concerning who performed procedures, where there was a response rate of 27 %. Questions concerning who performed the procedures were therefore not analysed further. The majority of the rGPs were on-call in municipalities with high centrality, in inter-municipal co-operatives and they had less than four shifts per month. During the period almost every rGP had experienced emergency patients with cardiovascular, respiratory or psychiatric problems.

Female rGPs reported statistically significantly less experience with emergency situations, and likewise for rGPs working in municipalities with high centrality or populations of more than 20 000 inhabitants. Half of the rGPs had been on a call-out and less than half had experienced a cardiac arrest. Less than one third had experienced a multi-trauma patient on at least one occasion during the last 12 months.

In emergency procedures venous access, oxygen on mask and IV medication/fluid were the most experienced procedures. Again, female rGPs reported statistically

significantly less experience in emergency procedures, and likewise for rGPs working in municipalities with high centrality or populations of more than 20 000 inhabitants. The rGPs working four or more shifts per month reported statistically significantly more experience in emergency situations and procedures, except for experience related to intoxication/overdose.

The majority of the rGPs reported being confident with respect to most of the emergency procedures, intubation being the exception. Logistic regression analyses supported the findings described both in experienced situations and procedures and in reported self-confidence in performing the emergency procedures.

7.5 Statistical analyses

All the statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 13 and 15). Standard descriptive statistics were used to characterise the different samples in all four studies. Data are presented as means (SD). Skewed distributed data are presented as median with 25–75 % percentiles. P-value <0.05 was considered significant in all four studies and differences between variables were analysed using Pearson's χ^2 test. Fisher's exact test was computed when tables had cells with frequency of less than five in 2x2 tables. Logistic regression analyses were performed in study II–IV to calculate odds ratios for relevant variables.

7.6 Ethical considerations

Paper I was a registry study based on municipal organisations without any personal or medical data. The Privacy Ombudsman for research approved the study (73).

Paper II was a sentinel monitoring of activity in the primary health care services without any registration of clinical patient data. The Privacy Ombudsman for research approved the study (73).

Paper III was a study where information on patients' medical problems and their full names were collected. In principle approvals from every patient were necessary, but this was not possible to carry out. An approval of the study was given by the Privacy Ombudsman for Research (73), the Regional Committees for Medical Research Ethics (74) and the Norwegian Directorate of Health (75), who gave the project manager exemption from professional secrecy.

Paper IV was a survey based on all rGPs' working patterns and experience in emergency medicine. No registrations regarding information on patients were made and ethical approval was not considered necessary.

8. Discussion

8.1 Discussion of methods

In order to establish descriptive data of the roles and experiences of doctors on-call, LEMCs and casualty clinics in emergency situations, a survey design was used in all four studies. Survey is a method used to establish knowledge from populations regarding several different variables, e.g. prevalence, behaviour, response and interrelations between variables. Like all types of research methods, surveys have advantages and disadvantages. Survey as a method gives the researcher the ability to establish a broad set of variables for data collection. An important disadvantage is the reduced control over independent variables, and cause and effect relationships are therefore more uncertain (76, 77).

Study I and IV are cross-sectional studies performed with a structured questionnaire. A cross-sectional survey provides information as it exists at a single time, e.g. the time when a person answers a questionnaire. A disadvantage with cross-sectional studies is the lack of time relations. Cause must appear before effect. Saying something about cause and effect relationships requires a time axis (76, 77). Study II and Study III were prospective longitudinal observational studies (77, 78), and data were collected in real time as they occurred along the time axis.

A discussion of some important methodological issues that have impact on the quality of the studies will follow. The discussion is basically about internal and external validity. Internal validity concerns the degree to which answers given or results extracted from a sample are correct. External validity concerns the degree to

which findings can be generalised from the sample to the entire population (76, 77). External validity is dependent on good internal validity.

Study I

Sample

All 433 (2006) municipalities answered the questionnaire in the registry study. Of those 433 municipalities 282 municipalities were responsible for their own emergency primary care services or were hosts to inter-municipal co-operations. The results are based on answers given from all 282 host municipalities and thus represent all the emergency primary care districts in Norway. The external validity is thus very good.

Information bias

The questionnaire was sent to the chief municipal medical officers, who answered the questions on the basis of the established routines in the emergency primary care districts. Differences between formally established routines and daily working patterns among the single doctors on-call probably exist. Formally established routines do not necessarily reflect the routines of every single doctor. A doctor can have access to a radio, but refuse to use it. Still, the data collected will hopefully reflect the real working patterns among the majority of the doctors, resulting in a minor impact on the internal validity.

Content validity

The aim was to analyse the preparedness of the doctors on-call to contribute in a case of a cardiac arrest or other life-threatening conditions, based on the emergency

primary care districts' established routines. Preparedness was operationalised as "use of the national radio network" and "access to a defibrillator". The variable "use of the national radio network" is clearly essential to questions about preparedness. Alarms from EMCCs or LEMCs to doctors on-call without radio routines will be delayed or not reacted upon. The emergency preparedness in a primary care district is closely connected to the ambulance services. Having no defibrillator does not necessarily reflect low preparedness if there is a good cooperation with the ambulance services, who always have a defibrillator in their ambulances. But the combination of no radio use and no access to a defibrillator represents emergency primary care districts with lower preparedness for emergency situations, especially so with respect to the municipalities without radio use.

Conclusion: All municipalities answered, which gave the study good external validity. As discussed, some information bias probably occurred, but the impact on the internal validity is probably minor.

Study II

A prospective observational study was performed. All contacts to a representative sample of emergency primary health care districts were collected. Some aspects of the design ought to be discussed.

Convenience sample

In 2007 all 431 municipalities in Norway were asked to take part in the study and 44 municipalities volunteered. Norwegian Social Science Data Service (73) chose the municipalities that were most representative for the Norwegian variety of municipalities and also reflected different organisational models for emergency

primary care districts. Based on the selection process seven emergency primary care districts were chosen with a total of 18 municipalities (16). 44 of the 431 municipalities would participate and this may have decreased the internal validity due to possible sample biases, and thus also the external validity of the municipality sample. Still, the Norwegian Social Science Data Service helped to secure as representative a sample as possible among the 44 volunteer municipalities.

Patients

All contacts to the primary care districts were recorded over the course of one year, resulting in a total of 85 288 patients. Thus, the total population of inhabitants that contacted the emergency primary care service and were triaged as red responses was included in Study II. The 85 288 patients were also considered as a sample of the total patient population that contacted the Norwegian emergency primary health care services. Based on the Norwegian Social Science Data service selection of municipalities, the patient sample can be considered to have a good external validity.

Rate of red responses

Differences in rates of red responses between the primary care districts were large. This could express differences between the emergency primary care districts' populations, which could yield different incidences of emergency medical problems. Access to rGP on daytime is unknown and differences with respect to such access could have an impact on the red response rate, especially during daytime. However, different triage patterns between the emergency primary care districts could be a more plausible explanation. There are probably cultural differences between the emergency primary care districts that affect the triage decisions. Those differences exist even with the use of the same tool to determine a red response. Differences

between the districts probably reflect the differences between the emergency primary care districts in Norway in general (79, 80).

Conclusion: Seven emergency primary care districts were selected by the Norwegian Social Science Data service and included in the Watchtowers. In virtue of the representativeness of the chosen emergency primary care districts and municipalities included, the external validity is strengthened. Still, due to the small numbers of municipalities to choose from, a possible sample bias has to be considered.

Study III

A prospective observational study where several variables were collected on every red response situation yielded reliable data. Still, some features concerning validity have to be discussed.

Convenience sample

Three EMCCs were asked to take part in the study. Norway has 19 EMCCs and all use the Index as a triage tool. Differences between the EMCCs and personal differences among the staff are probably unavoidable with respect to Index use (79). The selected EMCCs' representativeness for all EMCCs in Norway is uncertain and a possible sample bias could have impact on the internal validity (77), and thereby also on the external validity. Still, percentages of doctors on-call who received alarms were the same as in another study where all EMCCs in Norway took part (23). This strengthens the external validity for the data from the three EMCCs.

Sample size

A total population of 816 000 inhabitants lived in the catchment area, nearly 20 % of the Norwegian population. The incidence of medical problems and accidents should be representative for the total population. The external validity is also strengthened by the fact that we have included all red response patients from the study period.

Accuracy of scoring

NACA as a scoring tool was chosen because it is easy and suitable to use retrospectively when severity score was to be decided based on records from ambulances and doctors on-call. Another argument is that doctors in the air ambulances use NACA. The validity of NACA has not been verified, and it has been argued that the NACA is suitable to define life-threatening conditions for trauma victims, but it does still have a low accuracy when it comes to precise severity ratings (81). The NACA ratings of trauma and illness are also different between experienced emergency physicians and less experienced emergency physicians. A comparison between the two groups of physicians showed that the latter rated the same patient group with a lower NACA severity (82). Lack of verified validity and retrospective scoring could reduce the internal validity of the severity score on the patients in this study, and thereby also the external validity. However, the purpose was not to estimate an exact severity score on each patient, but to establish an overall knowledge on the severity of red response patients. A strength of the study is that only two persons have scored NACA (except for some of the patients taken care of by the air ambulance). This gives consistent NACA scores.

Coding of ICPC symptoms was done retrospectively based on received records, except for medical records from doctors in the primary health care where ICPC symptoms were already defined. To increase the internal validity we focused on

symptoms since diagnostic coding would have been too uncertain. A strength of the study is that only two persons have scored the ICPC symptoms (except for some of the patients taken care of by primary care services and where a medical record was accessible). This gives consistent ICPC symptom scoring.

Geographical areas

When the three EMCCs were chosen, the geographical areas were indirectly selected at the same time. The three EMCCs cover one fifth of Norway, and contain a total of 85 municipalities. The working patterns of the doctors on-call and the emergency primary care districts' established routines are expected to be representative for all primary care districts in Norway.

Red response cases

During the period of data collection we received 5 737 AMIS forms where 5 105 were included in the study. The rest of the AMIS forms were excluded because the degree of emergency was uncertain. Only cases that were initially defined as red responses were to be included, and during the coding process we could not ascertain the exact level of response in all the received AMIS forms. Some excluded AMIS forms were coded as both red and yellow, both yellow and red or as a single yellow or green response. Thus, the 5 105 coded cases are solely defined as red responses. This primarily increases the content validity of included red responses, which increases both internal and external validity. However, the conception of a red response is important. Study III is based on what the EMCCs triaged as a red response. It is not based on real clinical knowledge of the patients.

Conclusion: There are some aspects that have impact on the internal validity of the study and thus indirectly on the external validity. The strengths of the study are its completeness, number of variables included and a catchment area of 85 municipalities and 816 000 inhabitants.

Study IV

A survey using a structured questionnaire was sent to all rGPs in Norway. Some aspects of sampling, self-reporting and information bias are discussed.

Sample

The representativeness of the study was good. All rGPs in Norway were invited to participate and 78 % answered. 63 % took part in the out-of-hours services and of those 95 % answered the questions about experience in emergency situations. Another study from Norway showed that 65 % of the rGPs claimed reimbursement after out-of-hours work (6). The sample size and the response rate are both good and representative for the rGPs who took part in out-of-hours work. The external validity is therefore good.

Recall bias

The rGPs were asked about their experiences in emergency situations and procedures during the last 12 months. Recall bias has to be considered. Recall bias is more relevant for the most common emergency situations and procedures. It is probably difficult to recall the exact number of experienced situations of the most common types, such as chest pain. However, red response situations such as cardiac arrest or traffic accidents require immediate and special attention. They were less frequent and

recall bias should hence be reduced. This has also been discussed by others (39). Some recall difficulties are probably reflected in the response rate for individual items in the questionnaire. In questions about emergency procedures the response rate was between 74 % and 78% and in questions about self-confidence between 85 % and 91 %.

Definition of an emergency situation

In the questionnaire "emergency" was defined as "red response or situation where doctor's assessment was assumed to be urgent". A red response, as described in Paper III, is based on information from the caller and triaged using the Index. "A situation where doctor's assessment was assumed to be urgent" will probably have a broader definition than "a red response" based on the Index. Some will probably define "urgent" as the Index's yellow response. Emergency situations reported by rGPs are not invalid, but some of them may not correspond to an Index-based red response. However, for some doctors the definition used in the questionnaire will probably restrict the numbers of included situations. In a study from Austevoll "red response" alarms from the EMCC were often defined as yellow (71). As data from Austevoll showed, red responses based on Index and red responses based on clinic are not necessarily in accordance with each other.

Conclusion: The response rate in this study was good and the representativeness of Norwegian rGPs is a strength. The respondents have answered based on their own definitions and experiences with emergency situations, and not only emergency situations as defined by an EMCC. There is no restricting consensus on the content of an emergency. The figures on experienced emergency situations in Study IV are as relevant as the findings described in a recent published paper on epidemiology, based on data from the EMCCs (83).

8.2 Discussion of the results

During the research and writing periods of this project the concept “out-of-hours” and the definition of “general practitioner”, “GP”, changed. In the first paper “out-of-hours” is used as a translation of the Norwegian word “legevakten”. “Out-of-hours” means health care work performed after office hours. In Norway “legevakten” is also used to denote health care work performed during office hours. In the later papers the concept “emergency primary health care” is applied, and this denotes work performed both during out-of-hours and during office hours. In Paper I we also used “general practitioner” (“GP”) to denote the doctor on-call in the emergency primary health care services. This is changed to “doctor on-call” in the later papers. We decided that “doctors on-call” was more suitable, since many kinds of doctors work in the emergency primary care services in Norway, whereas just some of them are approved GPs. In Paper I “health regions” (“HR”) is used with the same meaning as “RHA”.

8.2.1 Municipal preparedness (Paper I)

The size of emergency primary care districts, with respect to population, had a median population of approximately at 7 000 inhabitants (2005/2006). A recent study from a small single emergency primary care district in Norway (The Austevoll study) gave a rate of 27 emergency patients per 1 000 inhabitants per year (71). This indicates an incidence of approximately 22.5 emergency patients per month in a typical-sized primary care district with 10 000 inhabitants. In the same study (71) patients were NACA scored and 13 % were scored between 4 and 6, meaning that the situations were potentially or manifestly life-threatening. 13 % gives a rate of 3.5/1 000 inhabitants per year, or 35 incidences of emergency patients per year (3 per month) with potentially or manifestly life-threatening conditions in emergency primary care districts with 10 000 inhabitants. The figures from the Austevoll study

corresponds to the figures in an earlier white paper, which estimated approximately two emergency cases per month where the time factor will be crucial in districts with a population between 5 000 to 10 000 inhabitants (27).

The absence of established routines in the municipalities and doctors on-calls not using the national radio network is a violation of existing regulation of prehospital emergency services (2). Paradoxically, it was doctors on-call in the emergency primary care districts with the smallest host municipalities (< 5 000 inhabitants) that most often used the radio to receive and acknowledge alarms. In other words, the highest preparedness level was found in emergency primary care districts with a low incidence of emergency patients per year.

However, the smallest emergency primary care districts are in most cases rural areas with longer driving distances and often fewer ambulance personnel with a certificate of apprenticeship (9). The need for doctors on-call participating in emergency situations is more evident in rural areas compared to densely populated areas such as cities. In cities the driving distances to hospitals and casualty clinics are in most of the cases shorter. A higher percentage of the ambulance personnel have a certificate of apprenticeship and they experience more emergency patients compared to rural areas. In remote areas the doctors on-call play a more crucial role in these critical situations, while in cities the doctors on-call are often bypassed, with patients being transported directly to hospitals. There are differences between cities. In Stavanger we know that doctors on-call receive alarms while in Bergen we know that doctors on-call never receive alarms in cases involving red response patients.

Cardiac arrests in the Austevoll study were 0.7/1 000 inhabitants per year. A population-based study on 816 000 inhabitants showed a rate of 0.9/1 000 inhabitants

per year of cardiac arrests, including all type of cardiac arrests like trauma, suicides and other “medical” problems (83). Unpublished figures from the same epidemiological study (83) showed that cardiopulmonary resuscitation was started in approximately half of the cases. The rest were pronounced dead at site. Thus, in a typically populated emergency primary care district with 10 000 inhabitants there will be approximately 5 incidents of cardiac arrests per year where cardiopulmonary resuscitation is attempted.

The estimates for cardiac arrest where it is deemed appropriate to attempt cardiopulmonary resuscitation have been too high in Norway. The Norwegian Resuscitation Council recently reduced the estimate for unexpected cardiac arrests outside hospitals where it seems to be useful to start cardiopulmonary resuscitation from 5 000 to 2 500 per year (84). All doctors participating in the out-of-hours work have to “share” 5 cardiac arrests per 10 000 inhabitants, during a year. A defibrillator will hardly be used in the course of a year. Doctors in the emergency primary care services will seldom experience a cardiac arrest. Nor will the ambulance personnel working in the same area. Nevertheless, it is well documented that a defibrillator is a crucial tool in resuscitation of a cardiac arrest. Thus, a defibrillator should be viewed as an obvious and natural part of emergency equipment. A defibrillator brought by a doctor on-call is may be more important in other emergencies than cardiac arrests, such as myocardial infarction, if the doctor is present when a cardiac arrest occurs. GPs equipped whit defibrillators in the UK were witnesses or very close to 46 % of 552 self-reported cardiac arrest cases, and GPs in a training network in Ireland witnessed 32 % of all cardiac arrests reported by the network group (85, 86).

Rural areas tend to be in a state of higher preparedness than emergency primary care districts in more urban areas. A typical averagely populated emergency primary care districts have few emergency cases per months. A consequence of an emergency

primary care service with high preparedness is more crucial for the patients in rural areas compared to urban areas. Urban areas have short access time for ambulances to hospitals and casualty clinics.

8.2.2. Red responses in the emergency primary care service (Paper II)

Red response cases represented less than three percent of the total number of patients who were in contact with the emergency primary care services in Norway in 2007.

With respect to first action taken, descriptive analyses showed gender differences as male patients more often got a consultation by a doctor and female patients more often got a call-out for doctors and ambulances. Call-out for doctors and ambulances were also more common in the oldest age group compared to the younger age groups. Overall, the largest differences were found with respect to gender, age group and mode of contacts. Regression analyses showed that the strongest association (odds ratio) was between first action taken and the oldest age group (60+). Consultation by doctor, call-out of doctor and ambulance, and "other" all yielded statistically significant associations (odds ratio) compared to other age groups. Differences between daytime, evening and night were smaller both with respect to mode of contact and with respect to first action taken.

90 % of all directly attending patients obtained a consultation by a doctor. Gender differences were found. Using female patients as reference value in the regression analyses there was a positive association between the categories "male" and "direct attendance", and a negative association between "male" and "consultation doctor". This contrasts with the descriptive analyses (table 2S; additional file 2, Paper II). Male patients differ from female patients by a lower probability of receiving a

consultation with a doctor or a call-out with doctor and ambulance. The association between male patients and “other” action taken was stronger. “Other” is basically a call-out with an ambulance, without a doctor. Ambulance personnel will more often take care of male patients compared to female patients, and it is likely that male patients are more often brought directly to hospitals. Female patients are more often offered a doctor to make the first judgment. Another explanation could be that men are sent directly to hospitals while female patients have to get their problem diagnosed and verified before hospitalisation.

The epidemiology of red response patients based on calls to the EMCCs showed minor gender differences, but cardiovascular symptoms were common among men over the age of 30, with a peak incidence in the age group 50–69 years. Women with cardiovascular symptoms tended to be older with a peak incidence in the age group >70 years (83). Thus, differences in first action taken could partly be explained by gender differences with respect to cardiovascular symptoms, where chest pain is more absent as a typical symptom in cardiac infarction among female patients (87).

Descriptive and regression analyses indicate that the definition of a red response is not uniform. All patients were triaged at arrival or by telephone when patients called the LEMCs. Still, some of the red response patients got a consultation by the doctors on-call as first action taken, others got a call-out with an ambulance, even when they came directly to the casualty clinic.

Several regression models were tried in different regression analyses during the initial statistical analyses. The independent variables used in the included regression analysis in Paper II are a compromise after several different regression models were tested, and the results discussed among the authors. The independent variable “out-

of-hours district" dichotomised as single municipal or inter-municipal districts was tried in preliminary analyses. Also "population" divided into three population groups; <20 000, 20 000–65 000, and >65 000 inhabitants was tried. The results in the preliminary regression analyses were not coherent and it was difficult to find any explainable pattern. One plausible explanation for this problem could be that seven emergency primary care districts are too few for the regression analyses, e.g. some inter-municipal emergency primary care districts had a population of the same size as some single municipal districts. The variables gender, age group and time of day were included in all the preliminary models.

Emergency primary care districts' main task is to take care of people in need of immediate medical attention or attention within a few hours. This is to be carried out in cooperation with the secondary health care system. The emergency primary care system is overcrowded with patients defined as green responses, i.e. the lowest priority (88). This problem is evident in casualty clinics in urban areas. In some urban areas casualty clinics are open for self-referrals. Casualty clinics are facing the same problems as EDs at hospitals with open access in that the majority of patients have minor problems (43, 55-59). Due to the large majority of green responses, preparedness and focus towards emergency patients among staff at casualty clinics will as a consequence decrease. The percentage of red responses (and yellow) in the emergency primary care service has to increase. The main initiative to increase the percentage of red responses must be to decrease the numbers of green responses. It seems like a majority of the visitors to the emergency primary care service use the casualty clinics as an ordinary medical office, instead of using their own rGPs. This problem is discussed by others (89).

A white paper from the National Centre for Emergency Primary Health Care recommends closing every casualty clinic to self-referral and force inhabitants to call the LEMCs in order to confirm the need for help (26).

8.2.3 Alarms to doctors on-call in the emergency primary care services (Paper III)

Difference in rates of red responses between the EMCCs was large. Innlandet had a rate of 30.6, Stavanger 19.9, and Haugesund 22.9 per 1 000 inhabitants per year (83). A study on triage in the emergency primary care service showed a large variation in rates of red responses between the districts, but it was argued that the differences reflected representative differences between districts in Norway (88).

The doctors on-call are obligated to be a part of, listen to and acknowledge alarms on the national radio system (2). There is no obligation to do a call-out on every alarm, but the doctors are in charge of the patients within their emergency primary care district when they receive alarms. This is the same system as the one used in the air ambulance services; it is the doctors' decision to attend to the patients at site (as long as weather/other flying conditions are not an issue). The NACA score indicated that 70 % of the patients are in a non life-threatening condition. The consequence of overtriage is probably one reason for the large percentage of "await" as a response among the doctors on-call in the emergency primary care services. Another cause for "await" is the way the emergency primary care services are organised today, with different possibilities for self-referral and a high percentage of minor problems that occupies doctors on-call (88, 89). Overall, the doctors in the emergency primary care service (rGPs and doctors on-call in the out-of-hours services) were a part of 50 % of the red response cases.

When doctors were the callers to the EMCCs there was no need to dispatch an alarm to the doctors in red response cases. All cases where doctors called the EMCCs were excluded when the percentage of alarms from EMCCs to doctors on-call were analysed. This could also have been done when other health care personnel and the LEMCs were the callers to the EMCCs, insofar as they called on behalf of a doctor. However, it is unknown when health care personnel called on behalf of a doctor and when they called without a doctor's knowledge. It is not possible to extract this

information from the AMIS forms. Therefore, the percentage of red responses where doctors on-call received alarms could be higher if calls from health care personnel and LEMCs were also excluded from the analyses.

The descriptive analyses in Paper III showed that when doctors on-call received alarms they responded more frequently with a call-out in life-threatening conditions compared to non-life-threatening conditions. This difference is largest in the area of Innlandet. When the doctors on-call received alarms they seemed to distinguish between the red response cases and made their own decision with respect to severity. The doctors on-call in the Austevoll study defined 39 % of all the red response alarms as yellow (urgent, not acute) immediately after the description of the situation was provided by the EMCC on the radio (71).

Again, the content of a red response is not uniform. Even with the use of the Index as a decision tool, there seems to be a certain vagueness in the content of the definition of potentially or manifestly life-threatening situations. 70 % were scored as non life-threatening situations retrospectively. Doctors on-call chose not to make a call-out in half of the red response cases. One cause for this could be that the doctors on-call were in disagreement with the EMCCs with respect to the level of severity. Other causes include different working patterns between doctors on-call and organisational differences between the different emergency primary care districts. Both working patterns and organisational differences will influence the response pattern among the doctors on-call.

The Regulation on emergency medicine outside hospitals (2) does not have any section where the use of the Index as triage tool is described as a rule to be followed. Furthermore, it is not stated in the Regulation that the EMCCs shall have a hegemony

with respect to defining red responses. The Regulation states that an evaluation of potential emergency situations shall be done 24 hours a day in the municipal emergency primary care services. Based on the evaluation the necessary actions shall be performed. If the doctor on-call does not define a case as a red response, an "actions evaluated as necessary" will be made on another triage level than the EMCC would expect. The secondary health care services dispatch an ambulance to a case defined as a red response. The doctor on-call defines the case as yellow or green and expects that the patient will be brought to the casualty clinic for a medical examination. In addition to this, as discussed earlier, differences in municipal preparedness probably have an important impact on the response pattern among doctors on-call. It is well-known that leaders of some emergency primary care districts disclaim the responsibility for red response patients outside casualty clinics and hospitals. This attitude affects the response pattern of the doctors on-call, and the secondary health care services are alone with the responsibility for the red response patients outside hospitals.

Regression analyses showed that the probability of receiving alarms was decreased (OR: 0.76) if the doctors on-call did not use the radio. That result cannot be considered astonishing. Yet, there is a much stronger association between which EMCCs area the doctors on-call worked in, and the probability of receiving alarms. The regression analyses are based on three EMCCs, and as mentioned earlier their representativeness is questionable. However, a national survey came to the same conclusion (23). 1.6 million inhabitants lived in municipalities where doctors on-call never received alarms (23). The EMCC area in which the situations occurred was the most important factor for whether the doctors on-call received alarms rather than their use or not of the radio.

When doctors on-call did not receive alarms 31 % of the patients were transported directly to hospitals without a doctor's confirmation. When doctors on-call did receive alarms the figures were 16 %. The differences with respect to direct transportations to hospitals could reflect the gatekeeper function performed by the primary care services. Dispatching alarms to doctors on-call will reduce direct transportations to hospitals and probably also unnecessary hospitalisation of patients. Differences in direct transportations to hospitals were not due to differences in patients' NACA score. Also, there were no obvious differences in the ICPC-symptoms score between those who were transported directly and those who were not. The single factor of whether doctors on-call receive alarms or not seems to reduce direct transportations to hospitals. Reducing the number of direct transportations to hospitals ought to be an important incentive to always dispatch alarms to doctors on-call.

For the total area there is a negative association between air ambulance on call-out and primary care doctor on call-out. The probability of a call-out among primary care doctors, when the air ambulance is on a call-out to the same patient, is reduced according to the regression analyses. The association (odds ratio) between rural areas and call-out is strong. The findings support the conclusion in an earlier study done in the area of EMCC Stavanger (90).

Preliminary regression models used in analyses included the age and gender of the patients. The variables age and gender did not have any statistically significant impact on odds ratio in the different analyses and were for that reason left out in the final analyses. Differences between the variables "air ambulance alarmed" and "air ambulance on call-out" did not exist in the regression analyses. We chose "air ambulance on call-out" as an independent variable.

8.2.4 Experiences among the general practitioners (Paper IV)

Doctors on-call in the rural areas would more often attend patients in red response cases. Doctors who worked in areas with more than 20 000 inhabitants had less experience in most of the emergency situations and procedures. The pattern continues for self-confidence, where the reported confidence was higher among rGPs working in municipalities with low centrality (rural municipalities). A doctor on a call-out in a more densely populated primary care district is rare compared to districts with less than 20 000 inhabitants.

GPs in Ireland have similar experiences in emergencies as the Norwegian doctors in the emergency primary care services (46). For comparable medical problems, e.g. chest pain, seizures and hypoglycaemia, the amount of experience was similar. The Irish GPs seem to have more experience in trauma situations. Half of the Norwegian doctors on-call were on a call-out at least one time during the 12 months period. It is claimed that the ambulance personnel in Norway increasingly often have to take care of emergency patients alone (4). An excellent working relationship between GPs and ambulance personnel in Ireland has been reported. GPs are positively inclined with regards to being part of the emergency care (91). What opinion Norwegian ambulance personnel have about the Norwegian primary care doctors is more uncertain. In a questionnaire among approximately 150 ambulance personnel, all with certificates of apprenticeship, 64 % answered that their cooperation with doctors in the primary care services was good (20).

We cannot estimate the rate of emergency incidences based on the general practitioners' reported experiences. In Study IV psychiatric problems were the second most common emergency problem experienced by the doctors. A recent Norwegian study showed that cardiovascular symptoms were most common, loss of consciousness second most common and respiratory symptoms third most common in

red response cases. Psychiatric symptoms constituted the fifth most common red response situations (83). However, the symptoms were retrospectively coded and psychiatric symptoms are among the most difficult symptoms to assess. Suicide figures per year from Statistics Norway are much higher than what the study referred to above showed. An obvius reason is that a person found dead seldom triggers a call to the emergency number (10, 83).

The results presented in Study IV consist of the rGPs' experiences, in contrast to data extracted from medical records (83). Red responses through the EMCC will not reflect the total epidemiological pictures of emergencies outside hospitals. In order to get a valid epidemiological picture, a study on the epidemiology of emergency patients outside hospitals in Norway has to include patients from both the emergency primary care services and from the secondary health care services.

8.2.5 Preliminary conclusion

Differences between the EMCCs with respect to whether the doctors on-call received alarms were large. Doctors working in emergency primary care districts in rural areas seem to be more prepared to act in emergency situations. They used the radio more often, they received alarms more often from EMCCs and they experienced more emergencies. More emergency procedures were carried out and a higher level of self-confidence with respect to emergency procedures was measured, compared to doctors working in more central primary care districts. Doctors in the emergency primary care service (rGPs and doctors on-call in the out-of-hours services) took part in 50 % of all the red response cases through the EMCCs. The EMCCs' pattern of dispatching alarms is the most important factor for whether the doctors on-call receive alarms or not. When alarmed the response pattern was more equal in the three EMCC areas among the doctors.

8.3 Political statements and reality

In the government's "Soria Moria" declaration (2005) equality in health care among all inhabitants regardless of where they geographically live, was confirmed as an essential principle (92). In addition to equality the health care system shall have enough recourses and the service shall be based on up-to-date professional health care workers. Cooperation between the primary and the secondary health care systems must be strengthened (92). Cooperation between the two levels of health care is also the main issue in a new report from the parliament, called "The Coordination Reform" (41).

The National Health Plan for Norway (2007-210) has "proximity and security" and "professionalism and quality" as two of its six main goals (1). Concerning proximity and security, the plan says the following:"*We want a decentralised pattern of settlement in Norway. The health service should support this. We want the entire population to have equal access to health services regardless of where they live*". Concerning professionalism and quality, the plan says the following: *The health service is a major knowledge-based organisation and the rate at which it is acquiring knowledge is accelerating. In general Norwegian health services maintain a high level of professionalism".*

Further discussion will address proximity, security, equality and professionalism in the emergency primary care system.

8.3.1 Proximity and security

Establishing more inter-municipal co-operations will increase the emergency primary care area, increase distances between inhabitants and casualty clinics and increase

driving time for doctors on-call to patients. During the last years there has been a centralisation of the ambulance services. Nearly a fourth of the municipalities did not have an ambulance inside their own borders in 2005. Most of the inter-municipal co-operations consisted of two municipalities. The largest co-operation consisted of 13 municipalities in 2005 (13). There are rarely doctors on backup duties to take care of red responses in areas with long driving distances for ambulances and doctors on-call. However, with the exception of a very small number of patients, response time will probably not affect the outcome (83). Still, patients can be in severe distress during waiting time, which does not support the concept of proximity and security.

Inhabitants in rural areas are entitled to the same level of advanced treatment as e.g. inhabitants in cities. But inhabitants in rural areas must accept longer waits before help arrives. There will never be the same prehospital response time in a rural municipality, with or without an ambulance, as there will be in a city.

Approximately 70 % of all ambulances on call-outs reached the patients within 12 minutes in Norway in 2006. However, for more than half of the municipalities the ambulances used nearly 40 minutes to reach 90 % of the patients on call-outs (9). The air ambulance's regularity is not good enough in many parts of Norway, especially in the western and northern parts (93, 94). Municipalities must never establish their emergency preparedness based on help from the air ambulance services as an incorporated and important contributor. In emergency situations where the time factor is crucial, "proximity to emergency health care service" is not the most apt description for inhabitants living in rural areas.

Half of the host municipalities did not follow the Regulation on emergency medicine outside hospitals (2). Radio use among doctors on-call was absent or irregular. Every

action or choice has a consequence. The consequence of not being a part of the radio system is that alarms to doctors will be delayed, if they receive them at all. If they receive alarms, the doctors will probably reach the patients after the initial medical examination is carried out by the ambulance personnel. The doctors have to rely on the findings or do a new examination. Lack of radio use decreases the inhabitants' security in emergency situations.

A white paper concerning the future emergency primary health care service addresses the problem of security (26). Every municipality shall be a part of inter-municipal co-operations. The necessity of establishing large and strong organisations where quality in emergency medicine will be in focus is needed. The ability to engage full time leaders in both administration and in medical quality assurance is necessary to support the political wish for a decentralised pattern of settlement. Larger inter-municipal co-operations will not decrease the proximity for the inhabitants living within the boundaries of the emergency primary care districts. Risk analyses based on epidemiology, incidence of red responses, and transport time in the area has to be considered. Decision makers can thus secure enough casualty clinics and enough doctors with second-call duty in the emergency primary care districts.

8.3.2 Equality and professionalism

The differences with respect to whether doctors on-call received alarms between the three EMCCs represent geographical differences in the professional level of medical help offered the patients. In some areas the doctor on-call received alarms together with the ambulance. In other areas the ambulances were the only medical unit that received an alarm. The geographical EMCC area in which the doctor on-call worked was the most important factor with respect to whether doctors received alarms or not (Paper III) and hence also the most important factor with respect to whether the

patients could expect to receive diagnostic competence at site. These differences in emergency care offered do not support the political wish for equality in health care. The EMCCs sent alarms to the doctors in just half of the red response cases. In addition to that, the doctors who received alarms responded with a call-out in less than half of the cases in which they received that alarm. The largest threat to equality is the lack of doctors receiving alarms in the emergency primary health care services, together with the fact that half of the emergency primary care districts were without organisational qualities that comply with the regulations (use of radio among doctors on-call).

The Norwegian Board of Health Supervision is dissatisfied with several organisational aspects in the emergency primary care services. The municipalities have to take more responsibility in order to secure quality and establish guidelines for doctors on-call that are in agreement with existing regulations and acts; "*Municipalities cannot deny their responsibility by referring to the responsibility general practitioners have themselves for providing services in accordance with sound professional standards"* (95). Thus, both the municipalities and the regional health authorities have to intensify the cooperation. The EMCCs must dispatch alarms to doctors on-call in every red response case. First action taken in the cases will be the decision of the doctor on-call. The municipalities have to take responsibility and secure that the regulation is followed and that radios are used among doctors on-call. In this way equality among inhabitants could be increased.

Professionalism concerns the experience and other qualifications of the doctors on-call. Only half of the rGPs take their anticipated shifts in the out-of-hours services (5, 6). The consequence is that out-of-hours shifts are taken by other doctors, such as junior doctors, doctors normally working in hospitals, and stand-in doctors from

other Scandinavian countries. They are authorised doctors, but their experience and knowledge is unknown. The extent of medical problems in emergency situations is large (83). The competency of general practitioners/doctors on-call is crucial for good quality in initial diagnosing and treatment decisions. Doctors on-call have less experience in more severe medical or trauma situations because there are too few patients with life-threatening conditions. Still, the expectation from the secondary health care services is that the doctors on-call shall attend patients in life-threatening situations with enough knowledge to manage the situations. As the only demand for extra education or training, approved GP specialists have to take a course in emergency medicine every fifth year to retain their approval. The assertion of a high level of professionalism is not supported in this area of the health care services. This challenge is also addressed in the white paper on the future emergency primary health care service (26). Emergency primary care districts with a stronger organisation, where it is possible to have employees dedicated to securing quality among staff and to securing that regulation is followed, have to be established.

According to the Regulation on emergency medicine outside hospitals (2) health care personnel shall answer calls to the LEMCs. The definition of "health care personnel" is very wide (28). The LEMCs are normally staffed with nurses. However, in one third of the LEMCs other health care personnel answered calls, the most common being medical secretaries (29). Medical secretaries do work with patient care in casualty clinics and experience in clinical practise is obvious. In LEMCs where medical secretaries answer and decide the level of response, insufficient experience and inadequate education among medical secretaries challenge the content of "professionalism". Lack of experience and medical updating among nurses are also threats to a proper service and a high level of professionalism. The withe paper on the future emergency primary health care (26) recommends having a bachelor degree and clinical experience to secure professionalism in the LEMCs.

In some geographical areas the doctors on-call responded with call-out in red response cases, in other areas the ambulance personnel have to take care of the problems alone. The majority of the red response patients are older people, often with high morbidity, comorbidities and thus a complex clinical picture. A study of the epidemiology of red response patients showed that 90 % of all red response situations were medical conditions and A10 “Chest pain” was the most used Index category for a red response (83). Of all 39 chapters in the Index five were used more than 8 % of the time, and two of those represent cases where the problems were known (A05 “Ordered mission”) or the problems were unknown (A06 “Inconclusive problem”). Seven of the chapters were hardly ever used and six were not used at all (83).

One of the problems to be addressed is the use of the Index in the EMCCs. The large variations in medical symptoms were in contrast to a narrow use of the Index as a decision tool in the EMCCs (83). To the best of our knowledge a thorough evaluation of the Index has never been performed in Norway. The necessity of 39 chapters, as well as the contents of the chapters, needs to be evaluated. The large majority of the red responses were given a NACA score indicating non-life-threatening situations. Overtriage in dispatches is well known and demanding on the resources involved in emergency health care outside the hospitals (96-98). More focus towards the emergency system outside hospitals, including triage and dispatch, and how best to deal with “everyday” emergency problems, is needed in Norway. This will increase professionalism because the right resources will be used on the right patients at the right place. The dispatch system with the Index as a triage tool is probably not in accordance with the knowledge and ability of reflection that doctors on-call are capable of doing. Use of the Index creates a mismatch of expectations between personnel at the EMCCs and ambulance personnel on one side and the doctors on-call on the other. A consequence is reduced equality and professionalism.

8.4 Conclusions

In many geographical areas the time before a professional caregiver reaches the patient can be very long. In a number of municipalities doctors will not be able to defibrillate before the ambulance is on site. There are some indications that doctors in small municipalities are in a higher state of readiness to attend an emergency, compared to what is the case in more densely populated areas. They are more likely to bring a defibrillator and also to use the radio system. Use of the radio system among the doctors on-call is a significant marker for readiness to act in emergency situations.

In the emergency primary health care services in Norway, red responses count for less than three percent of all contacts. Still, on a national basis this adds up to more than 42 000 patients per year, out of which one third is routed through the EMCCs. Most patients call the LEMCs or meet directly at casualty clinics. Half of the red responses resulted in a call-out for a primary care doctor and ambulance. The results emphasise that the GP-based emergency primary health care service in Norway constitutes an important part of the medical emergency system, every hour and day of the year.

Primary care doctors on-call and the primary health care system with rGPs during daytime took part in clinical judgement and treatment in half of all red response cases. For one third of the patients a clinical judgement was made before an EMCC was contacted. The inhabitants in the catchment area were offered different levels of professional medical judgement and treatment. There are differences between the EMCC areas in terms of the frequency of emergency primary care doctors on-call receiving alarms. Call-out as a response was more similar among the doctors. More clinical assessment at scene from doctors on-call may lead to better medical care and to more relevant transportation routes.

Norwegian rGPs took active part in emergency treatment, especially in rural areas. RGPs doing out-of-hours work are exposed to many different emergency situations. They take responsibility without any formal requirement of emergency training. Knowledge of different emergency clinical problems is important and the rGPs should master a variety of practical skills and emergency procedures. However, individual rGPs rarely experience these situations, something that emphasises the need for regular training. Regular training with quality evaluations should probably be mandatory for rGPs taking part in out-of-hours work. This will increase the level of professionalism in the emergency primary health care system.

The municipalities have to fulfil the regulations, the secondary health care services have to dispatch alarms to the doctors on-call in all red response cases. The emergency primary health care system needs a more thorough regulation where tasks, qualifications and cooperation with the secondary health care services are accurately described in specific paragraphs.

9. Further research

Based on the four papers presented in this thesis some areas for further research have emerged. The development of the municipalities' level of preparedness to act in emergency situations must be monitored. National data on the municipalities' fulfilment of their responsibilities and participation in emergency medicine are needed.

When the plan for the future emergency primary health cares service (26) is carried out, differences between the system of today and the new organisation have to be monitored. It will be important to measure several variables that can provide information on municipal preparedness, e.g. the use of radio among the doctors on-call, triage performed by the LEMCs and the amount of participation of doctors on-call at site.

Findings described in Paper III indicate that more research is needed on the entire emergency system. A thorough evaluation of the Index as a decision tool is needed. National-based statistics on the epidemiology in both red and yellow responses are needed. Knowledge of changes in the epidemiology and where and by whom the patients are examined and treated is important. Knowledge is important for the medical leaders in the emergency systems, as well as for politicians in order to make the right decisions for the future organisation. A national consensus is needed to secure that every part of the out-of-hospital emergency services records the same variables with the same meaning. This requires a national standard for ambulance records, AMIS use in the EMCCs, and a national standard for data collection among the emergency primary care districts.

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